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# THE SCHOOL MAGAZINE.

FEBRUARY, 1881.

HEALTH DEPARTMENT.

*Editor: A. Hamilton, M. A., M. D., Port Hope, Ont.*

THE SCHOLAR'S EYE.

VI.

## “WEAK SIGHT.”

THE statement that a scholar has “weakeyes” is made frequently. It is the asthenopia of the oculist. There are some popular misconceptions on the subject which are worth rectification. Weak sight is not a disease. It is a symptom only, and is found with several diseases and diseased conditions. This symptom is often spoken of in referring to a given pupil, as though it were itself an all-sufficient explanation, whereas it is no explanation at all. In like manner, if we say that a given person is weak, that contains no explanation of his debility. It may be from lack of food, overwork, recovery from a recent illness, deficient quality of food, intemperate or other habits, disease actually present, or other cause not included in any of these. Where weakness of sight is part of a general debilitated condition actually known to exist this is one explanation of what exists. Among children of school age this is

not common in this country, where food is cheap and of good quality, and consequently all well fed. The other conditions on which it depends are fairly numerous. They include the several conditions already treated of in this series of papers on the Scholar's Eye. Where the scholar is quite well in every other respect, the cause is to be looked for in the eye itself. There, it may be either disease or some congenital malformation, as short sight. It often requires a most patient sifting and analysis of symptoms to elucidate a case to one's satisfaction. The condition on which it depends being known, if possible, treatment appropriate for each case follows. Complete cure may or may not be possible. It is not to be expected from any single means. The intelligent do not expect a wonderful single panacea for such varied conditions. The ignorant, with credulity rampant, are ever after some marvellous remedy to which they can give blind faith in its efficacy to meet absurdly different or even opposite conditions.

## VENTILATION OF SCHOOL-ROOM.

A few facts are worth stating on the subject of Ventilation in the school-room, because of their practical import. The general subject cannot be here entered on. For that, we would need, in a given school-room, to know the size of room, how situated in the general building, how warmed and so on. Certain principles come into play in every school-room and these are here stated briefly.

A cubic foot of warm air is lighter than a cubic foot of cooler air. Therefore air warmed by stove or the living body is continually ascending. The upper part of a room is therefore warmest. Besides this direction upward however, there is the chemical law of diffusion of gases coming into play and acting constantly. This largely diffuses and equalizes the heat. As the air becomes vitiated by respiration it should be allowed to escape. The vent should manifestly be either through the ceiling, or by an opening in the upper part of the room. As the vitiated air escapes above, its place must be taken by air from below, which enters through every possible crevice. In this way a gradual change of air occurs. It should be so managed as to have no considerable current of cold air anywhere. The power of the outer air to force itself through openings varies directly as the difference in atmospheric pressure within and without. The pressure will vary with the heat in the room and the freedom of exit combined. In a large school-room some pupils are necessarily seated near the window or other openings. If these windows be the

only means of admitting fresh air into the room there will necessarily be draughts. The direction of this unavoidable draught is important. If directly into the room at right angles to the surface of the walls it has its maximum of evil effect. If directed directly upward, and the point of delivery be sufficiently high, there need be no discount on the benefits of ventilation. Even with the ordinary window this may be managed in one of two ways \* either elevate the lower sash an inch or two, and place under it a piece of board which perfectly closes the opening so made. Air will then enter between the upper and lower sash, and the direction of the current will be upward. The same end may be got in the other way: lower the upper sash and place something, as a plate of zinc, which shall direct the current upward. However, where there is a proper place for air to enter, there need be none enter at the window. Such other entrance should be towards the top of the room. The cool air will then become gradually mixed with the other air in the room, and there will be no sudden lowering of temperature at or near the portion occupied. Such outer opening should be somewhat high for another reason: if low impure ground air will be taken in. Pupils placed in proximity to a window are in a cold part of the room, independently of draughts, because there is a radiation of heat through the transparent glass. Still better than the opening directly into the upper part of the school-room is that it shall enter elsewhere and be warmed before it enter the school-room, or be impelled to pass the stove before being breathed.

## THE EXAMINATION AND CERTIFICATING OF TEACHERS.

By Miss Kate Balentine, Stratford.

NOTHING human is perfect. From our earliest years we have heard this truth asserted in various forms; from the days when we first began to observe evident proofs of it have been presented to our notice every moment of every day. If we have the courage and industry always to scrutinize our own motives we must often be painfully conscious how large an amount of alloy is mingled with them even when they seem most pure. In the record of the greatest benefactors of our species we always find much we must blame mingled with their many good works. In the greatest masterpiece of the greatest masters in any department of art, science or literature, some flaw is always to be found. All this everybody knows; and yet how long it is—if indeed that time ever comes—before we are trained to expect that this universal imperfection shall pervade every new thing to which we are to be introduced; before we fully take home the humiliating truth that everything that comes from man's heart, or his head, or his hand, will certainly be a mixture of good and evil in greater or less proportions; that till death shall sign our release we must battle against the evil and that, battle bravely as we may, we shall never *wholly* overcome it, but this should not discourage us. It is always possible to make head against it, and besides in every undertaking there are greater evils and lesser ones, and if there is nothing more, there is a choice between them, and this choice it is important we should wisely make. Let us see how far this has been done in admitting candidates to practice the profession of teaching.

There are two professions from which more than all the others it is vitally important that all unqualified practitioners should be rigidly excluded—the professions of medicine and of teaching. The evil effects of malpractice in medicine, even when not fatal, strike so unmistakably at man's interest by depriving him of comfort and of the means of acquiring wealth, that they are readily recognized; and though a quack who makes pretensions to superhuman skill will always find dupes who will reverence him the more the less his claims stand within the prospect of belief, yet he is not likely to impose on people more than once. The injuries he can inflict are easily discoverable. On this account the necessity for some competent tribunal pronouncing sentence as to the fitness of a candidate for practicing the profession of medicine is so well recognized that any practitioner who is proved not to have a diploma may be prosecuted and punished. It is not so with malpractice in teaching. The injuries which this inflicts deprive the injured indeed of many comforts—of many inestimable blessings, but they are comforts and blessings he has never known. They cut off from him many modes of acquiring wealth, but they are modes of which he has an imperfect knowledge, and which he is easily led to regard with wondering respect as something beyond his reach. These injuries are negative rather than positive, and as they operate by stunting the growth of that part of man invisible to the bodily eyes they cannot be discovered but by those who have not suffered by them—whose mental vision

has been developed. This we suppose accounts for the fact that not only there is no penalty for practicing teaching without a license, but that quacks are not even punished when they have inflicted a lasting injury. It is true that when the state establishes a system of education for her children, she protects licensed teachers from competition with unlicensed ones in her own schools by the simple means of refusing to employ the latter. But we maintain that this does not comprise her whole duty. Not only in the interests of the teachers—though as a body of public servants who have spent much time and money in fitting themselves to discharge their duties to the state their interests should by no means be disregarded—but in the sacred interests of her future citizens she should demand of everyone who wishes to practice teaching in any school proof that he is competent to discharge the great duty of training the boys and girls of the present to be the healthy, intelligent, God-fearing men and women of the future. To take a particular instance, we think the interests of the future women of this Province would be greatly served if the Government would claim and exercise some salutary supervision over the educator employed and education given in that class of establishment known as young ladies' colleges, young ladies' seminaries, or by some such high sounding title, which send out yearly bevy of graduates whose very slender acquirements are surmounted by an immense edifice of half-mastered showy accomplishments, and who are puffed up with so lofty an estimate of this species of knowledge that there is slender hope of them ever adding to the aforementioned solid substructure. But to return to our subject. We have said that it is most necessary that those who aspire to be teachers should be required to produce proof of their fitness to discharge these duties, and that this

necessity has been recognized in the case of teachers whose salaries the Government assists in paying. It is the efficacy of the means employed in proving the candidates, as well as the utility of the conditions under which the certificates are granted, that we intend to consider in this paper.

A qualified teacher, according to the intention of the law, must be a person of good moral character, whose literary attainments reach a certain standard, and who possesses a satisfactory knowledge of the theory of teaching and of the best methods of practicing it. The proof of his moral character must be the testimony of some reliable person who knows him. The proof of his literary attainments is a certificate from a regularly constituted Board of Examiners that he has passed an examination in the subjects the law requires him to be acquainted with. He comes to the examination hall at an appointed time, and writes down answers to ten or twelve questions in ten or twelve or more subjects. These questions are supposed to exhaust the subject within the prescribed limits, and a certain value is given to each, and according to the answers handed in the candidate is judged.

Now this method of testing knowledge is probably the best that can be devised, and may be made more or less thorough according as the examiners are more or less skillful in framing questions, and more or less discriminating in weighing the value of questions. But after all it is an imperfect test. Different persons will always look at subjects in different ways, and it is quite possible for a candidate to have a good knowledge of a subject obtained from one teacher and fail utterly at an examination set by another. But this is not the worst. It is better they say that ten guilty persons should escape punishment in the criminal courts than that one innocent should suffer. We will venture to reverse the statement in this

case. It would be better, we firmly believe, that ten deserving applicants should be turned away for the time than that one undeserving one should pass. And it is unhappily possible for persons whose minds have been totally unawakened—whose every word proclaims that their observation of and taste for good English is sadly uncultivated—who have absolutely nothing of that stamp which distinguishes the learned from the unlearned to pass the examinations prescribed for teachers at least of the lower grades. How can they do it? Why, by being judiciously—or rather we should have said very *injudiciously* examined. There are many teachers whose reputation for preparing pupils for examinations stand very high, who have acquired that reputation by being able to introduce into the candidates' heads just enough of knowledge of facts to pass through the examination with just as little explanation and just as little collateral information as possible in order that no time may be lost. The injury done to those subjected to this process is great; but that done to those they will afterwards teach is incalculable. Having none of that ardent love of knowledge which makes the acquiring of it one of the choicest pleasures of life, how can they communicate even a spark of this love to others? Having nothing of it themselves how can they train others to appreciate and seek to possess that

—“Thinking mind

That in realms of thought and books can find

A treasure surpassing Australian ore?”

They will have no ambition to do it for they will never dream such a thing can be done. Like the graduates of the young ladies' colleges, mentioned before, they will have their lack of culture supported by such a fund of conceit that they will live their lives and go down to their graves without ever suspecting that they know nothing whatever of true education.

We will sum up in a few words our

estimate of written examinations. They are imperfect tests, for they do not fulfill the end of distinguishing infallibly between those whose knowledge fits them to become teachers of others and those who are unworthy of that high trust by reason of their want of knowledge. But they are an acknowledgment that the public has a right to expect that the teacher's education shall be thorough, and from year to year by gradual improvements they will become more and more reliable; let us hope this in spite of present appearances. Then they imperatively demand that the candidate shall *prepare* to become a teacher, and though it is possible, as we have seen, to go through the form of preparation without actually being greatly benefited, still the majority of the candidates are benefited, and this majority will become greater and greater as time goes on and “the common sense of most” puts down cramming.

They have greatly lessened the probability of unqualified practitioners finding their way into our schools. When all that was required of a teacher was to sound his own praises and use a sufficient number of polysyllabic words to impress the average country trustee with a lofty estimate of his learning, our schools were in too many instances presided over by swaggering, blustering, often drunken pedagogues, whose only reason for becoming teachers frequently was that they could do nothing else, and who were scarcely worthy to be intrusted with the care of their own children. Some of this kind still linger around the country a disgrace to their profession and a reproach on the intelligence of those who employ them; but their reign is always of short duration. The contrast between them and the worst of the new class of teachers produced by a better order of things is too apparent not to be perceived by all.

After the candidate has satisfied the examiners that his literary attainments

reach the required standard he has another ordeal before him through which he must successfully pass before he is entitled to the parchment which constitutes him a qualified teacher. He has learned the names and the nature of the books to be used in the education of his future pupils ; he must now learn how to use them. For this purpose he is placed under the charge of a Model School teacher who is to impart to him by precept and example a knowledge of the methods of communicating his already acquired information to others, as well as how to govern and classify his school. He is moreover required from time to time to show that he is reaping benefit from what he hears and sees by taking charge of a regular teacher's class for short periods ; and if he does this with success and can at the end of the term pass a satisfactory examination on the principles and practice of teaching he is entitled to the certificate of qualification that he seeks.

Now, theoretically this system is an excellent one, and we have no doubt whatever that the training received in the Model School is of great benefit to the candidate, and enables him to proceed to work much more intelligently and systematically and consequently with much greater ease when he actually enters upon the duties of the school-room. We believe it is very wise to exact of him a knowledge of the theory of teaching and a clear idea of how to put it into practice ; and a written examination in education, though liable as in other written examinations to discriminate imperfectly, is still the best that can be applied. But we must say, and we say it without hesitation, that our opinion of the teaching abilities of a candidate would remain quite unchanged if though we had before us the concurring testimony of all the Model School masters and teachers in the country as to his success or failure to manage the classes temporarily en-

trusted to his care. Can any ex-candidate forget the sensation he experienced when he stood up in the presence of his critic to give his appointed lesson? Does he remember how wildly his heart beat, how his voice trembled, how every mistake and every misdemeanor on the part of the pupils and every quick glance from the teacher filled him with the despairing conviction that now his fate was sealed and his reputation as a teacher forfeited forever ; and how before this conviction his little stock of self-possession quite vanished. And does he not remember too that mingled with these sensations came the half indignant thought, "I *could* teach if no one were watching me." He cannot do himself justice. The thought that he is being watched and that his certificate depends upon his success absents his whole mind and prevents the free exercise of its powers. This may not be the case with all but it is the case with many. We have known instances of those who had only succeeded in passing after repeated trials and then with but little credit, approving themselves in actual practice most successful teachers ; and on the other hand we have seen those whose stronger bodily nerve carried them safely and with honor through their first model term show themselves afterwards to have at least no more than average teaching abilities. Even if the powers of the mind were allowed free play, there would still be much to be taken into account before we could safely argue from one's success or failure to teach in a Model School to his ability to teach in his own. In the former his position is very different from the one he holds in the latter. He has no real authority over his class ; he feels it and they know it. He has no means of acquiring that individual knowledge of his pupils so necessary to successful teaching. He has none of that stimulating pride of ownership. All those things must be taken into

account; and after they have been allowed for, as we said before, we should place little value on the verdict. We wish to be understood that while we are unwilling to regard the marks obtained at these trials as a fair criterion of the candidate's ability to teach, we are nevertheless of opinion that he derives great benefit from the practice. There is no doubt that teachers trained in the Model Schools waste much less of their pupils' time at the beginning of their professional course than those who had no such training; but it is, we think, equally beyond doubt that if we should keep a list of the teaching marks obtained by a certain number of Model School candidates for comparison with a statement of their respective standing with each other after a few years of school-room work, it would be possible that we should find that the first had become last and the last first. If the two reports did agree it would be a remarkable coincidence and nothing more. Would we then, it may be asked, altogether discard the system of "marking" for the teaching done by candidates while in training? Yes, we would. We would give them the training; we would endeavor to be satisfied of their knowledge of the principles explained and illustrated for them by an examination, and then we would send them to their work feeling that they had taken the best precautions in our power. And to those who would object, "We have no certainty that they are able to teach," we would emphatically reply, "The marks they would have obtained would not have increased your certainty."

The certificate granted to the young candidate when the period of probation has been successfully passed over is granted only for a period of three years. We suppose that the originators of this idea were not actuated, as one might at first sight suppose, by a belief that a stock of knowledge is like a stock of victuals and is exhausted in

the specified time. The motive of course was to make it necessary for the teacher to go on with his education or leave the profession.

All the regulations for the examination and certificating of teachers were framed not for the benefit of the individual teacher but to raise the standard of the schools; and it may well be questioned if this one has the desired effect. Many of our school boards can never or will ever engage any but the lowest grade of teachers for at least some of the classes in their schools. Now, a large number of these teachers who leave the profession when their certificates expire would remain in it but for the difficulty and inconvenience of having to prepare for a new examination. If their places were supplied by those whose greater ambition urged, and more favorable opportunities enabled them to raise their certificate a grade higher it would certainly be a very desirable state of affairs. But this is not the case. The teacher who has added to his practical training the experience of three years, and whose preparatory knowledge has of necessity been increased in all the departments he finds himself daily called upon to teach—this teacher steps out and makes room for one whose knowledge and ability are just about what his were when he began; therefore it would be difficult to show in what way the school is a gainer and not a loser by the exchange. If the third class certificates were made permanent those who could go on with their studies would find incentives enough to do so in the higher salaries paid to the higher grade of teachers and the less drudgery required of them; and many members would be secured to the profession who do excellent work in their own schools, but who for many reasons find it impossible to prosecute their studies to the extent required for passing the higher examination. We believe this aspect of the question will in time



recommend itself to those who make our school laws.

In none of the other professions is a degree once conferred taken away again; and anyone who fulfils the condition required for becoming eligible as a teacher for the lowest grade has a right to have his standing as such permanently recognized. If he really possesses the qualifications which his certificate supposes, his presence in the ranks will always be desirable; if he be one of those imposters who got in through the inevitable loopholes in the tests we must leave him to be detected by those with whom he comes into contact professionally, and want of employment will soon drive him to seek his livelihood by means of some other work for which he is better suited or where at least he will do less harm. We would have something to say of that regulation which limits the sphere of work of the holders of third class certificates, but an ample remedy for its inconvenience was provided at its birth by the dispensing power granted to inspectors, and as it is rarely or never put in force no argument seems necessary to prove that it is mischievous or useless. No one believes it is of any use now.

Of the examinations of teachers for the higher grades of certificates, as distinguished from those we have already treated of, we have little to say. There is an increased probability that the education of those who succeed in

passing them is what it appears to be, because their time of preparation has been longer, and likewise because the cramming process is generally followed by a strong reaction, so that those who have been forced by means of it through one examination usually have their minds unfitted for receiving much additional education rightly or wrongly administered; just as one's stomach would be unfitted for performing its digestive functions no matter how judiciously food were taken if it had once been outraged by being treated with food as the intellects of the unfortunate victims of cramming are treated with facts. Of course it is possible for some to undergo the process a second time, as some people's digestive organs would also hold out under similar treatment longer than others; but as we have before remarked the probability of its having been done is much less than before. And so we may hope with considerable assurance that their minds have received that amplification and its different powers that strengthening which constitutes the truly educated person, and which is the chief end to be kept in view in imparting knowledge.

The two higher grades of certificates are granted to those who earn them as free from trammels as possible. This is but justice. Teachers are quite sure to find annoyances enough even for this vale of tears in the actual duties of their profession without having any imposed from without.

RECEIPT FOR MAKING COMPOSITION BLACK-BOARDS ON THE WALLS OF SCHOOL-ROOMS,—For 20 square yards of wall:—take 3 pecks of mason's putty; 3 ditto of clean sand; 3 ditto of ground plaster; 3 lbs. lampblack, mixed with three gallons of alcohol.—*Note.*—The alcohol and lampblack must be mixed before it is put into

the plaster. This sort of black-board is in use in the Normal and Model Schools, Toronto, and has in every respect answered the purpose admirably. A cloth or lambskin wiper should be used to clean the black-board. A narrow trough should also be placed below the black-board to receive the chalk and wiper.

## ENGLISH GRAMMAR AND ETYMOLOGY.

FIRST CLASS TEACHERS—GRADE C.

(Continued from last month.)

9. Illustrate from the passage the various senses in which the prepositions *with*, *for* and *to* are used.

"With such large discourse." In this clause *with* is used to denote attendant circumstances. The original meaning of *with* was separation, which passed into that of opposition, thence to proximity, and proximity suggests association, the sense in which *with* is most commonly employed.

"With divine ambition puffed." We saw already that *with* may be used to denote attendant circumstances. Among the attendant circumstances of an action is the instrument with which it is performed. This is the sense, viz., that of instrumentality in which *with* is used in this clause.

"For a fantasy and trick." *For* is used here in the sense of exchange.

"For a plot." *For* is used here in the sense of, in defence of, or in behalf of.

*To* is variously used in the passage, sometimes as a mere sign of the infinitive, as to do, sometimes with a genuine prepositional force as with the gerundial infinitive where it means in order to, &c., as "to hide."

In the phrase, "To all that fortune," "To their graves," here *to* indicates that to which motion is directed.

"To my shame." *To* here means tendency to, that is, that the action spoken of tends to produce in me the feeling of shame.

10. What peculiarities of metre do you observe in the extract. Comment briefly upon them.

In lines 1, 8, 11, 15, we find super-

fluous syllables in the last foot. In lines 7, 9, 10, 12, 29, we apparently have a superfluous syllable according to the orthography employed, but probably not according to the pronunciation on the stage. In lines 2 and 34 there is a syllable wanting. With reference to the first peculiarity mentioned, it may suffice to say that the heroic lines in the time of Shakespeare was not restricted with such rigid accuracy to ten syllables as it was in the time of Pope. It was allowable to introduce a superfluous syllable in any foot with the proviso that it be not admitted in the adjoining feet.

With regard to the second class of peculiarities, the most probable explanation is the word *reason* (l. 7), *whether* (l. 8.), *coward* (l. 12), were contracted in pronunciation to monosyllables, *whether* becoming *wh'er*. In line 10 "the event" would naturally be contracted to "th'event;" and in line 29 *imminent* would be shortened into a dissyllable by eliding the middle vowel.

With respect to the last peculiarity, the omission of a syllable, the explanation is that the unaccented syllable is omitted only where a pause takes place; or in other words, that the pause supplies the place of the unaccented syllable, as for instance, the pause before "what" in line 2, and the pause before "O" in line 34.

There is noticeable also in some lines the common license of beginning the line with a trochaic foot instead of an iambus for the sake of giving variety to the metre.

11. What part of speech is "even"

(l. 22)? "enough" l. 33)? Justify your answer.

"Even" is clearly in this instance an adverb modifying the following adverbial phrase, "for an egg shell." There is no other phrase or word in the sentence that it could possibly modify. In sentences like the following one: "Even Homer sometimes nods," Mr. Abbot is of the opinion that, even here, "even" should be regarded as an adverb modifying an implied adjective or phrase, as "Even (so wakeful a poet as) Homer, &c."

Though Mr. Mason has laid it down as a rule that "enough" should be treated either as a noun, or as an adverb, we confess that we cannot very well see how "enough" can be treated as an adverb here. It seems to mean "Of sufficient magnitude," *i. e.*, "To be of sufficient magnitude to hide the slain." Taking this view, "enough" must be treated as an adjective.

12. *Sith*. What modern English derivative from this, and how formed?

The words *sith tham* meant "after that." *Sith tham* became contracted into *sithen* and still further shortened into *siz*. To *siz* the adverbial genitive termination *es* which became *ce* in sound and spelling, was added; and thus from *sith* the derivative *since* was formed.

13. What different meanings are borne by these words—*worth*, *then*, *event*, *stake*, *cause*, and how do they get these different meanings?

Consult Worcester's Dictionary.

14. Notice and explain grammatical peculiarities in the following:

(a)

"I am his first-born son that was the last That wore the imperial diadem of Rome."

(b) "There was therefore, which is all that we assert, a course of life pursued by them different from that which they before led."

(c)

"Villain, knock me at this gate,  
And rap me well."

(d) "Whom he would he slew, and whom he would he kept alive."

(e) If I open my eyes on the light, I cannot choose but see."

(a) The peculiarity in this sentence arises from the fact that *his* is regarded as the antecedent of the relative pronoun *that*. This is in accordance with the old use of *he*, &c., as a substantive pronoun. *His* should not be treated in parsing as a mere possessive adjective but as a demonstrative pronoun in the possessive case, and equivalent to the phrase *of him*.

(b) Here the peculiarity consists in the early introduction of *which* to refer to the sense of what follows.

(c) In this sentence we have an example of what is known as the *ethical dative*. The pronoun representing the person to whom the thought is of special interest, or for whose benefit an action is performed, is put in this *ethical dative* case. The peculiar structure is not much used now, but is frequent in language of Shakespeare and other writers of his period.

(d) The antecedent to the relative pronoun is omitted altogether in this sentence. *Whom* appears to be used as relative and antecedent in the objective case governed by both verbs immediately following. This is a very unusual use of the relative, though Milton has "To whom we hate."

(e) *But* in this sentence appears to have the force of a preposition except. "But see" is equivalent to "except to see." The meaning is, "I cannot choose unless I choose to see."

15. Correct what is wrong in these sentences, giving your reasons:

(a) Two or more singular nouns, coupled with *and*, require a verb in the plural.

(b) There's ne'er a villain dwelling in all Denmark

But he's an arrant knave.

(c) Early to bed and early to rise  
Make a man healthy, wealthy, and wise.

(d) —Who riseth from a feast  
With that keen appetite that he sits down.

(e) Some were insensible and some were invincible against the assaults of the flesh.

(f) The ambassador brought them the draught of an article, and asked them whether it were satisfactory.

(a) The mistake in this sentence consists in using the preposition *with* instead of *by*. *With* may mean mere association and not necessarily instrumentality.

(b) This sentence is correct as it stands. *But* is here equivalent to "except that." The meaning is that "There is no villain in Denmark unless he is one."

(c) It is an error here to pluralize the verb *make*. The subject of this verb is the idea underlying the previous line, and hence the verb should be singular.

(d) "That he sits down" is incorrect. It is obviously wrong to use a relative pronoun in the sense of a preposition and relative. This clause can be amended by saying "That he sits down with," or "With which he sits

down." The first method would be more in accordance with the structure of the language in the time of Shakespeare.

(e) "Insensible" and "invincible" do not take the same preposition after them. Hence the sentence should read, "Insensible to the assaults of the flesh and invincible against them."

(f) The subjunctive mood is here incorrectly used for the indicative. The ambassador would not inquire whether it *were* satisfactory, but whether it actually was so. The last clause should read, "Whether it was satisfactory."

16. Give some account of the origin of the verbs "shall," "can," "ought."

Book-work. See Mason's grammar.

17. Explain the derivation of ancestor, ephemeral, cenotaph, hurricane, sovereign, animalcule, decision, prelate, thralldom, distemper, morose, assassin.

Consult Chambers's Etymological Dictionary.

18. Write a short note on the defects and redundancies of the English alphabet.

Bookwork. Consult any work on English grammar.

## MATHEMATICS.

### *Solutions to Problems from Correspondents.*

1. To describe an equilateral triangle equal to any given triangle.

Let ABC be the given triangle; through A draw AD parallel to BC, at the point B in the line BC make the angle CBD equal to two-thirds of a rt. angle; in BC take BE such that the square on BE is equal to the rectangle DB, BC; in BD take BF equal BE; BFE shall be the equilateral triangle required.

2. Upon a given base to describe an isosceles triangle having the third angle treble

of each of the angles at the base.

The triangle of ACD in the figure of Prop. 10, Book IV., is the triangle required.

3. To divide a straight line into two parts such that the square on the one part may be three times the square on the other part.

Let AB be the given straight line. At A make the angle BAC equal half a right angle and at B make the angle ABC one-third of a right angle, and from C, where these lines meet, draw CD perpendicular to AB; the

square on DB shall be three times the square on AD.

4. Given a square and one side of a rectangle which is equal to the square, find the other side.

This may be considered a particular case of Book I. prop. 44, namely, when the given angle is a right angle.

5. In the figure of I. 43, if K be the common angular point of the parallelograms about the diameter and BD the other diameter, shew that the difference between the parallelograms EH and FG is equal to twice the triangle BDK.

The four triangles AHK, HKD, DKF, FKC together make up half the parallelogram ABCD; so also do the five triangles AKH, AKE, HKD, EKB, KBD. But AHK, HKD are common to both, and DKF is equal to EKB, therefore FKC is equal to AEK and KBD hence KBD is equal to the difference between FCK and AEK and therefore twice KBD is equal to the difference between the parallelograms GF and EH.

6. To divide a circle into two segments such that the angle in one of them shall be five times the angle in the other.

The angles will be 30° and 150°; then apply III. 34 to cut off from a circle a segment containing an angle equal to one-third of a right angle.

## TRIGONOMETRY PAPERS.

### JUNIOR MATRICULATION, 1880.

1. Define the common logarithm of a number.

If  $x$  be the logarithm of  $N$  to base 2, and 41.664 be the logarithm of  $N$  to base 8; find the common logarithm of  $x$ .

2. Prove

$$(1) \log \frac{ab}{c} = \log a + \log b - \log c.$$

$$(2) \log \sqrt[n]{a^m} = \frac{m}{n} \log a.$$

$$(3) \text{Find Log } \cos 80^\circ \sin 45^\circ.$$

3. Perform the following operations by means of logarithms:

$$(1) \text{ Divide } 416.64 \text{ by } \sqrt{623640}.$$

(2) Find the value of

$$\frac{(.25)^{-5} \times \sqrt[3]{.072}}{(527 \cdot 58)^{10}}$$

4. Having given

$$L \sin 28^\circ 21' = 9.676562.$$

$$\text{Difference for } 1' = 234,$$

$$L \tan 61^\circ 39' = 10.267852.$$

$$\text{Difference for } 1' = 302,$$

Find (1)  $L \cos 28^\circ 21' 20''$ ; (2)  $L \sin 123^\circ 18' 30''$ ; (3) the angle the Log of whose secant is 10.055468.

5. Prove

$$(1) \tan A = \sqrt{\sec^2 A - 1};$$

$$(2) \cos a = \cos (2n 180^\circ \pm a).$$

$$(3) \cot 3a - \tan^2 a = \frac{4}{\tan 2a \sin 2a}$$

6. Prove the following, when  $A + B$  is less than  $90^\circ$ , and without assuming the formulae for  $\sin(A + B)$  and  $\cos(A + B)$ :

$$(1) \tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}.$$

$$(2) \cos 2A = 1 - 2 \sin^2 A.$$

7. If  $\tan A$  and  $\tan B$  be the roots of the equation

$$x^2 - 4nx + 1 = 3n, \text{ shew that}$$

$$A + B = 2 \tan^{-1} 2 - 1 \text{ or } = 2 \tan^{-1} (-2)$$

8. In any triangle  $ABC$ , prove the following formulae:

$$(1) \frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}.$$

$$(2) \tan \frac{1}{2} A = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}}.$$

If  $AD$  bisects the angle  $A$  and  $AE$  is drawn perpendicular to the base  $BC$ , shew that

$$\cos DAE = \frac{b+c}{a} \sin \frac{1}{2} A.$$

9. Having given

$$(1) b = 103.5, c = 520.14, C = 90^\circ \text{ solve the triangle.}$$

$$(2) a = 388.98, b = 139.20, C = 91^\circ 48', \text{ find } A, B, \text{ and } c.$$

$$10. \text{ If } \begin{cases} \sin B - \cos A = a \\ \sin A - \cos B = b \end{cases}$$

shew that  $\tan \frac{1}{2}(A - B) = \frac{a - b}{a + b}$   
 and  $\sin(A - B) = \frac{a^2 - b^2}{a^2 + b^2}$

11. A person finds the elevation of the bottom of a flagstaff on a tower to be  $30^\circ$ ; receding 60 feet up a hill, which is inclined  $24^\circ$  to the horizon, he finds the elevation of the top of the staff to be  $30^\circ$ ; shew that the length of the flagstaff is 56.050...feet.

| NUMBER. | LOG.  | ANGLE.                              | LOG.     |
|---------|-------|-------------------------------------|----------|
| 20000   | 30103 | $\tan 78^\circ 31'$                 | 10.69241 |
| 30000   | 47712 | $\sin 88^\circ 12'$                 | 9.99979  |
| 62364   | 79494 | $\operatorname{cosec} 68^\circ 42'$ | 10.03071 |
| 41664   | 61976 | $\tan 24^\circ 26'$                 | 9.66067  |
| 24918   | 39651 | $\tan 44^\circ 6'$                  | 9.98645  |
| 50974   | 70735 |                                     |          |
| 10350   | 01494 |                                     |          |
| 52758   | 72229 |                                     |          |
| 38838   | 58926 |                                     |          |

SENIOR MATRICULATION, 1880.

1. Define the common logarithm of a number. What is the characteristic of the logarithm of 20,000; (1) to base ten, (2) to base twelve, (3) to base one hundred, (4) to base one-tenth?

2. Explain the arrangement of tables of logarithms whose mantissas consist of six figures. Given

mantissa of  $\log. 128340 = 108362$

" "  $128350 = 108396$

construct a table of proportional parts for intermediate numbers.

3. Perform the following by logarithms:

(1) Divide .121744 by 166.772

(2) Find the value of

$$\frac{24^6 \times .36^{-2}}{5 \sqrt{4.5}}$$

4. Find the value of  $\cos 30^\circ$ ,  $\sec 45^\circ$ , and  $\tan 120^\circ$ . Find also the tabular logarithms of these ratios.

5. Prove the formulas:

(1)  $\tan A = \tan(180^\circ + A) = \cot(90^\circ - A)$ .

(2)  $\sin^2 A + \cos^2 A = 1$

(3)  $\tan 2A = \frac{2 \tan A}{1 - \tan^2 A}$

6. In any triangle prove the following;

(1)  $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$

(2)  $\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$ .

(3)  $\tan \frac{1}{2}(A - B) = \frac{a - b}{a + b} \cot \frac{1}{2}C$ .

7. Having given

(1)  $a = 127, A = 37^\circ 17', C = 90^\circ$ ,  
find  $b, c$  and  $B$ .

(2)  $a = 200, b = 173, c = 227$ ,  
find  $A, B$ , and  $C$ .

8. The angles of a triangle are in the ratio of 1, 2, 8, and the longest side is  $\sqrt{3}$ , find the angles, the other sides, and the area of the triangle.

9. Shew that

$$\tan A = \frac{1 - \sec 2A + \tan 2A}{1 + \sec 2A - \tan 2A}$$

10. Shew that the length of the line AD which is drawn to the side BC produced, of a triangle, so as to bisect the exterior angle at A, is

$$\frac{2bc}{b - c} \sin \frac{1}{2}A$$

| NUMBER. | LOG.   | ANGLE.              | LOG.     |
|---------|--------|---------------------|----------|
| 200000  | 301030 | $\tan 29^\circ 4'$  | 9.745008 |
| 300000  | 477121 | $\tan 23^\circ 39'$ | 9.641199 |
| 730000  | 863323 | $\tan 37^\circ 17'$ | 9.881680 |
| 166772  | 222124 |                     |          |
| 121744  | 085447 |                     |          |
| 178630  | 251955 |                     |          |
| 127000  | 103804 |                     |          |

FIRST YEAR, 1880.

1. Define the logarithm of a number and explain what is meant by the "base" of a system of logarithms.

Shew that  $\log. \frac{a^n}{b^m} = n \log. a - m \log. b$ .

Find  $\log. 176$  and  $\log. 6860$ .

Of what numbers are  $2, 0.3, 0.25$  the common logarithms?

2. Find the logarithm of the square root of

$$\frac{\sqrt[3]{577}}{49 \cdot \sqrt{686}}, \text{ and of } \frac{\sqrt{.002}}{\sqrt[3]{.07}}$$

3. Define the terms sine, cosine, and tangent, and make a table of their variations in magnitude and algebraic sign from  $0^\circ$  to  $180^\circ$ .

Having given the tangent of an angle find the sine and cosine.

4. Find the sine, cosine and secant of  $30^\circ$  and  $45^\circ$ .

5. If  $ABC$  be a triangle, right-angled at  $C$ , shew how to find any of the quantities  $B, a, b$ , if  $A, c$ , are given.

6. Prove that

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$

$$\sin 3A = 3 \sin A - 4 \sin^3 A$$

7. Prove the following formulæ:

$$\cos a = \frac{1 - \tan^2 \frac{1}{2}a}{1 + \tan^2 \frac{1}{2}a}$$

$$\sin(45^\circ + a) \sin(45^\circ - a) = \frac{1}{2} \cos 2a.$$

$$\sin^2 A - \sin^2 B = \sin A + B \sin A - B.$$

$$\frac{\sin a + \sin 3a}{\cos a + \cos 3a} = \tan 2a.$$

$$\tan 67^\circ 30' = 1 + \sqrt{2}.$$

8. In any triangle prove

$$(i) \cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

$$(ii) \cos \frac{1}{2}A = \sqrt{\frac{s(s-a)}{bc}}$$

9. Solve completely the triangles:

(i)  $a = 1263, b = 1359, c = 1468.$

(ii)  $A = 67^\circ 59', a = 2045, b = 2000.$

10. Find the areas of the triangles in question 9.

12. The elevation of a tower is found to be  $45^\circ$ , and on retiring 60 yards it is  $30^\circ$ , find the height of the tower.

| NUMBER. | LOG.   | NUMBER         | LOG.    |
|---------|--------|----------------|---------|
| 12630   | .10140 | 70000          | .84510  |
| 13590   | .13322 | 78200          | .89321  |
| 14680   | .16673 | 79561          | .90070  |
| 14948   | .17458 |                |         |
| 16124   | .20747 |                |         |
| 20000   | .30103 | ANGLE.         | L. SIN. |
| 20450   | .31069 | $46^\circ 58'$ | 9.86389 |
| 30000   | .47712 | $52^\circ 54'$ | 9.90178 |
| 57700   | .76118 | $59^\circ 7'$  | 9.93360 |
| 68600   | .83632 | $65^\circ 3'$  | 9.95745 |
|         |        | $67^\circ 59'$ | 9.96711 |

FIRST CLASS A, 1880.

1. If  $a$  be the circular measure of an angle between  $0^\circ$  and  $90^\circ$  then  $\sin a > a - \frac{1}{2}a^2$ .

Prove that  $\sin 10'' = .000048481368$

2. Find the sin of  $(A + B)$  and the cos of  $(A - B)$ .

3. Prove that

(1)  $\cos^2 A - \cos^2 3A = \sin 4A \sin 2A$

(2) If  $\cos(A + B) - \cos(B + C)$

$$\frac{\cos(A - B) - \cos(B - C)}{\cos(B + C) - \cos(C + A)}$$

$$= \frac{\cos(B - C) - \cos(C - A)}{\tan B \tan C}$$

then  $\frac{\tan \frac{1}{2}(C + A)}{\tan \frac{1}{2}(A + B)}$

4. Given the sides of a triangle, determine the cosines of its angles.

If  $A, B, C$  be the angles, taken in order, which the bisectors of the sides of a triangle drawn from the opposite angles make with the sides they bisect then will

$$\cot A + \cot B + \cot C = 0$$

5. Eliminate  $e$  between the equations

(1)  $a = \operatorname{cosec} e - \sin e$

$b = \sec e - \cos e$

(2)  $(a + b) \tan(c - k) = (a - b) \tan(e + k)$

$$a \cos 2k + b \cos 2e = c$$

6. Investigate expressions for the radii of the escribed circles of a triangle.

If  $r$  be the radius of the inscribed circle and  $a, c, s$  the radii of the escribed circles, shew that

$$\frac{1}{r} = \frac{1}{a} + \frac{1}{c} + \frac{1}{s}$$

7. In the triangle  $ABC$ , if  $BC = a$ ,  $CA = b$ ,  $AB = c$ , prove that

$$(1) \cos 2A + \cos 2B + \cos 2C + 4 \cos A \cos B \cos C = 1.$$

$$(2) (b+c) \cos A + (c+a) \cos B + (a+b) \cos C = a + b + c.$$

8. Two sides of a triangle are 85.63 feet, and 78.21 feet, and the angle they include is  $48^\circ 24'$ , find the remaining angles.

$$\log 163.84 = 2.2144199$$

$$\log 7.42 = .8704039$$

$$L \cot 24^\circ 12' = 10.3473497$$

$$L \tan 5^\circ 45' = 9.0030066$$

$$L \tan 5^\circ 46' = 9.0042721$$

9. State De Moivre's theorem.

Prove that the expression

$$(\cos a + \sqrt{-1} \sin a)^p (\cos a - \sqrt{-1} \sin a)^q$$

has  $q$  different values and no more,  $p$  and  $q$  being integers prime to each other.

10. Apply De Moivre's theorem to express  $\sin na$  and  $\cos na$  in terms of  $a$ .

Deduce the series for  $\sin a$  and  $\cos a$  in terms of  $a$ .

## HOW TO TEACH MENTAL ARITHMETIC.\*

By J. H. Knight, P. S. Inspector, Lindsay.

**T**O conduct a class successfully in Mental Arithmetic the questions and answers should follow each other in rapid succession, and each pupil should answer correctly as many questions as possible. To carry this out the questions must be progressive, and new difficulties should not be approached too abruptly.

**Position.**—The most satisfactory plan is to have the pupils stand on the floor in a class, and take places, that is, those who answer go above those who miss. When this cannot be done, the pupils should all stand at the commencement of the exercises, and those who answer correctly sit down, while those who miss remain standing until they have answered some question. Then all stand and proceed as before.

**Time.**—From three to five minutes after another subject is better than half-an-hour at a stretch. In mixed schools two or more classes may often be put together with advantage.

**Preparation.**—Neither teacher nor

pupils should use any text books during the exercise. The teacher should be ready to give the questions without delay, and to decide with certainty as to the correctness of the answers. The blackboard may be used occasionally for illustration.

**Review.**—Keep on giving new questions as long as the answering is satisfactory. Whenever the answering lags repeat questions which have been answered before. In review the easiest questions may be omitted, until eventually the questions are taken promiscuously.

The following exercises are prepared upon the supposition that Reduction and the Compound Rules follow the Simple Rules, and that only enough of fractions is taken at that stage to enable pupils to understand those rules. It is not intended that one exercise should be finished before another is commenced, nor that they should necessarily be taken exactly in the order in which they are here given. The object is not to prevent the teacher preparing

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his own questions, but to guide those who have but limited resources, and to suggest to others who from lack of time or from any other cause, may need such assistance.

### EXERCISE I.—TIME.

How many seconds in a minute? In 2 minutes? In 3 minutes, &c., up to 60 minutes.

How do you find how many seconds in an hour?

*Answer.*—Multiply 60 by 60.

Why do you multiply 60 by 60?

*Answer.*—Because there are 60 seconds in a minute, and 60 minutes in an hour?

How many minutes are there in an hour? In 2 hours? In 3 hours? &c., up to 24 hours. How do you find how many minutes in a day? Why do you multiply 60 by 24? How many hours in one day? In 2 days? In 3 days? In a Week? Why do you multiply 24 by 7?

How many days in January? &c. How many days in January and February together? In February and March? &c. How many days in January, February and March? In April, May and June? How many days in the first six months of the year? (Name them.) How many days in July, August and September? In October, November and December? How many days in the last six months of the year? (Name them.) How many days in the year?

From 9 o'clock till 10 o'clock how many minutes? Till 11 o'clock? Till 12? Till 1? Till 2? Till 3? Till 4? From 9 o'clock till 10.30? Till 11.30? Till 12.30, 1.30, 2.30, 3.30? From 9 o'clock till 10.15? Till 11.15? Till 12.15, 1.15, 2.15, 3.15? From 9 o'clock till 10.10, 11.10? &c. From 9 o'clock till 10.20, 11.20? &c. From 9 o'clock till 10.40? &c. Till 10.50? &c. Till 10.05? &c., &c. Till 10.25? &c. Till 10.35? &c. Till 10.55? &c.

### EXERCISE II.—LONG MEASURE.

How many inches in a foot? In 2 feet? In 3 feet?

How do you find how many inches in a yard?

*Answer.*—Multiply 12 by 3.

Why do you multiply 12 by 3?

*Answer.*—Because there are 12 inches in a foot, and 3 feet in a yard?

How many inches in half a yard?

How do you find how many inches in

$\frac{1}{2}$  yard? How many inches in  $\frac{1}{4}$  yard? How many inches in  $\frac{3}{4}$  yard?

How do you find how many inches in

$\frac{3}{4}$  yard? How many feet in 1 yard?

In 2 yards? In 3 yards? In 4 yards?

In 5 yards? How many feet in  $\frac{1}{2}$  yard?

In  $1\frac{1}{2}$  yards, in  $2\frac{1}{2}$  yards, in

$3\frac{1}{2}$  yards, in  $4\frac{1}{2}$  yards, in  $5\frac{1}{2}$  yards?

How do you find how many feet in a

rod? How many feet in 2 rods, in 4

rods, in 6 rods, in 3 rods, in 8 rods, in

10, 12, 14 rods, &c., up to 40 rods?

How many yards in 2 rods? in 4

rods, &c., up to 39 rods? How do

you find how many yards in a furlong?

Why do you multiply  $5\frac{1}{2}$  by 40?

How many rods in a furlong? in 2 fur-

longs, &c., up to 8 furlongs? How do

you find how many rods in a mile?

Why do you multiply 40 by 8? How

many rods in  $\frac{1}{2}$  mile? in  $\frac{1}{4}$  mile? in

$\frac{3}{4}$  mile?

How many yards in 1 mile? in  $\frac{1}{2}$

mile? in  $\frac{1}{4}$  mile? in  $\frac{3}{4}$  mile?

### EXERCISE III.—WHEAT.

How many lbs. in a bushel of

wheat? in 2 bushels? in 3 bushels,

&c., up to 10 bushels? How many

lbs. in  $\frac{1}{2}$  bushel? in  $1\frac{1}{2}$  bushel? in

$2\frac{1}{2}$  bushels, &c., up to  $9\frac{1}{2}$  bushels?

How many bushels in 100 lbs.

*Answer.*—1 bushel and 40 lbs.

How many bushels in 200 lbs.? in

300 lbs., &c., up to 1,000 lbs.? How

many bushels in 150 lbs.? in 250 lbs.?

&c., up to 950 lbs.?

1 lb. at \$1.20 a bushel, 2 lbs., 3, 4,

5, 6, 7, 8, 9, 10, 20, 30, 40, 50 lbs.?

1 lb. at 90c. a bushel, 2 lbs., 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 40, 50 lbs.?

1 lb. at 75c. a bushel, &c., up to 50 lbs.?

1 lb. at \$1.05 a bushel, &c., up to 50 lbs.?

1 lb. at 80c. a bus., &c., up to 50 lbs.?

1 lb. at \$1.00 a bushel, &c., up to 50 lbs.?

1 lb. at 70c. a bushel, &c., up to 50 lbs.?

*Note.*—The answers may be given  $1\frac{1}{8}$  cent,  $2\frac{3}{8}$ ,  $3\frac{3}{8}$  at first, and more correctly afterwards.

1 lb. at \$1.10 a bushel, &c., up to 50 lbs.?

1 bus. 1 lb. at \$1.20 a bus., 2 bus. 2 lbs., 3 bus. 3 lbs., &c., up to 50 bus. 50 lbs.?

1 bus. 2 lbs. at 90c. a bus., 2 bus. 3 lbs., 3 bus. 4 lbs., &c., up to 50 bus. 51 lbs.?

1 bus. 3 lbs. at 75c. a bush., 2 bus. 4 lbs., 3 bus. 5 lbs., up to 50 bus. 52 lbs.?

1 bus. 4 lbs. at \$1.05 a bus., 2 bus. 5 lbs., 3 bus. 6 lbs., &c. up to 50 bus. 53 lbs.?

1 bus. 5 lbs. at 80c. a bus., 2 bus. 6 lbs., 3 bus. 7 lbs., etc., up to 50 bus. 54 lbs.?

1 bus. 6 lbs. at \$1.00 a bus., 2 bus. 7 lbs., 3 bus. 8 lbs., etc., up to 50 bus. 55 lbs.?

1 bus. 7 lbs. at 70c. a bus., 2 bus. 8 lbs., 3 bus. 9 lbs., etc., up to 50 bus. 56 lbs.?

1 bus. 8 lbs. at \$1.10 a bus., 2 bus. 9 lbs., 3 bus. 10 lbs., etc., up to 50 bus. 57 lbs.?

110 lbs. at \$1.20 a bus., 220 lbs. 330, 440, etc., up to 990 lbs.?

120 lbs. at 90c. a bus., 230 lbs., 340, 450, etc., up to 890 lbs.?

130 lbs. at 75c. a bus., 240 lbs., 350, etc., up to 900 lbs.?

140 lbs. at \$1.05 a bus., 250 lbs., 360, etc., up to 910 lbs.?

150 lbs. at 80c. a bus., 260 lbs., 370, etc., up to 920 lbs.?

160 lbs. at \$1.00 a bus., 270 lbs., 380, etc., up to 930 lbs.?

170 lbs. at 70c. a bus., 280 lbs., 390, etc., up to 940 lbs.?

180 lbs. at \$1.10 a bus., 290 lbs., 400, etc., up to 950 lbs.

123 lbs. at \$1.20 a bus., 234 lbs., 345, 456, 567, 678, 789 lbs.?

101 lbs. at 90c. a bus., 202 lbs., 303, 404, etc., up to 909 lbs.?

111 lbs. at 75c. a bus., 222 lbs., 333, 444, etc., up to 999 lbs.?

121 lbs. at \$1.05 a bus., 221 lbs., 323, 424, etc., up to 929 lbs.?

131 lbs. at 80c. a bus., 232 lbs., 333, 434, etc., up to 939 lbs.

141 lbs. at \$1.00 a bus., 242 lbs., 343, 444, etc., up to 949 lbs.?

151 lbs. at 70c. a bus., 252 lbs., 353, 454, etc., up to 959 lbs.?

161 lbs. at \$1.10 a bus., 262 lbs., 363, 464, etc., up to 969 lbs.?

(To be continued.)

CHEMISTRY.

UNIVERSITY OF TORONTO, 1880,

*Prof. Pike's Chemistry Papers, answered by F. H. Mackel.*

1. State fully what facts are represented by the equation,  $2\text{NO} + 2\text{H}_2 : \text{N}_2 + 2\text{H}_2\text{O}$ .

Ans:—This means that two molecules of Nitric Oxide together with two molecules of

Hydrogen yield one molecule of Nitrogen and two molecules of water.

If equal volumes of Hydrogen and Nitrogen dioxide are brought together, water is formed

and Nitrogen is left. The volume of Nitrogen left is equal to half the volume of Nitrogen dioxide taken, or in other words Nitric Oxide has one-half its volume Nitrogen and hence its formula should be NO and not  $N_2O_2$ .

Why should it not be written thus :



If this method were adopted it would indicate that one molecule of Nitric Oxide, together with one molecule of Hydrogen yield one atom of Nitrogen and one molecule of water. This cannot be, then an atom of Nitrogen cannot exist in a free state and hence to get two atoms of Nitrogen the quantities present must be doubled or, in other words, molecular formula must be used.

2. What reason have we for thinking that air is not a chemical compound but a mixture?

Ans :- We have various reasons :

(1.) The relative qualities of Oxygen and Nitrogen present in the air sustain no relation to their combining weights or any multiple of their combining weights.

(2.) When Oxygen and Nitrogen are brought together in any proportion, and even in the proportion in which they generally form air, no heat is produced, no change of volume is observed and yet the mixture possesses all the properties of air.

(3.) When air is shaken up with water, some of the Oxygen and Nitrogen is dissolved, but not in the proportion in which they occur in air.

If the water containing Oxygen and Nitrogen in solution be boiled and the gasses collected, it will be found that the relative proportion of the two gasses is that of 1 : 1.87, in air it is as 1 : 4.

3. Describe the preparation of Sodium Carbonate, Sodium bicarbonate and Caustic Soda (Sodium Hydrate), from Sodium Chloride. Give equations respecting the chemical relations which occur.

Ans :-



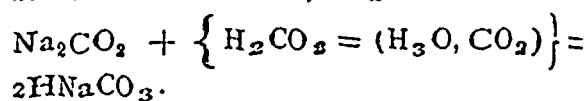
The manufacture of  $Na_2CO_3$  from Na Cl is divided into two stages, the Salt Cake pro-

cess, by which  $CaSO_4$  is formed, and the Black Ash process, by which the body in question is obtained.



In the "Black Ash Process" the  $Na_2SO_4$ , formed by heating NaCl and  $H_2SO_4$  in a reverberatory furnace, is mixed with Carbon and ( $CaCO_3$ ) Calcium Carbonate in Balling furnace and heated until it fuses. The decomposition takes place in two stages, in the first Sodium Sulphide is formed,  $Na_2SO_4 + 2C_2 = Na_2S + 4CO$ . This Sodic Sulphide now acts upon the Calcic Carbonate, Calcic Sulphide and Sodic Carbonate being formed,  $Na_2S + CaCO_3 = CaS + Na_2CO_3$ .

Sodium bicarbonate ( $HNaCO_3$ ) is formed by exposing the disodic Carbonate to the action of Carbonic acid,  $CO_2$ .



If to Sodium Carbonate and water quicklime ( $CaO$ ) be added and the mixture boiled, insoluble Calcium Carbonate will be formed, NaOH remaining in solution. By filtering off the  $CaCO_3$  and evaporating the filtrate in a silver basin to dryness, the NaOH remaining is fused and cast into sticks.

4. Give a short account of the preparation of mercury and its principal compounds. Calculate the percentages of Mercurous Nitrate  $Hg_2(NO_3)_2$  :  $Hg = 200$  :  $N = 14$  :  $O = 16$

$$Hg_2(NO_3)_2 = \left\{ 400 + (14 + 48) \times 2 \right\} = 524.$$

Then in 520 parts by weight of  $Hg_2(NO_3)_2$ , there is 400 Hg.

Then in 1 " " " there is  $\frac{400}{524}$  Hg.

Then in 100 " " " there is  $\frac{400 \cdot 000}{524} = 76.3$ .

Again in 524 parts by weight of  $Hg_2(NO_3)_2$ , there is 28 N.

Then in 1 " " " there is  $\frac{28}{524}$  Hg.

And in 100 " " " there is  $\frac{28 \cdot 000}{524}$  Hg.

In 524 of  $Hg_2(NO_3)_2$  there is 96 of O  
 " 1 " "  $\frac{96}{524}$  of O  
 " 100 " "  $\frac{9600}{524}$  of O,  
 = 18.32.

Then the percentages are 5.34 of N.  
 18.32 of O.  
 and 76.33 of Hg.

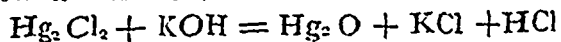
The ore from which Mercury is obtained is Mercuric Sulphide  $HgS$ . If this Sulphide be roasted Sulphur burns off as Sulphur dioxide, the Mercury volatilizes and is condensed in pipes.

The compounds of Mercury are divided into two classes, the Mercurous and the Mercuric. In the Mercuric compounds Hg acts as dyad  $HgO$ , in the Mercurous compound the double atom acts as a dyad  $Hg_2O$ .

|     | Mercurous.     | Mercuric.    |
|-----|----------------|--------------|
| } = | $Hg_2O$ ..     | $HgO$        |
|     | $Hg_2Cl_2$ ..  | $HgCl_2$     |
|     | $Hg_2(NO_3)_2$ | $Hg(NO_3)_2$ |
|     | $Hg_2S$ ..     | $HgS$        |

$HgO$  Mercuric Oxide is obtained by moderately heating the Nitrate, Mercurous Oxide being left as a red crystalline powder. If Caustic Potash be added to the Nitrate the Oxide falls as an amorphous yellow powder.

If Calomel  $Hg_2Cl_2$  be digested with excess of Caustic Potash (KOH)  $Hg_2O$  as a black powder is formed, thus :



If heated to  $100^\circ$  it decomposes into  $HgO$  and Hg.

4.  $Hg_2Cl_2$  Mercurous Oxide or Calomel.

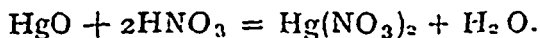
This is prepared by heating corrosive sublimate ( $HgCl_2$ ) and Metallic Mercury (Hg) together, three parts of the Mercury to four of the Sublimate being taken. It is found that the metal combines with half of the Chlorine, thus :  $HgCl_2 + Hg = Hg_2Cl_2$ .

The Calomel sublimes and is condensed and washed to free it from the soluble  $HgCl_2$

$HgCl_2$  Mercuric Chloride or Corrosive Sublimate is obtained by heating together equal parts of Mercuric Sulphate and Sodid Chloride, or by simply burning Hg in Chlorine gas.

$Hg(NO_3)_2$  Mercuric Nitrate is obtained

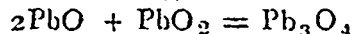
by the action of Oxide of Mercury upon excess of Nitric acid.



$Hg_2(NO_3)_2$  Mercurous Nitrate is obtained by the action of dilute Nitric acid upon excess of Mercury.

$HgS$ , Mercuric Sulphide, Cinnabar or Vermillion as we have seen, occurs in nature and may be artificially prepared by heating a mixture of Sulphur and Mercury. If Sulphuretted Hydrogen be added to any solution of a Mercuric salt, black Mercuric Sulphide falls. This black precipitate upon sublimation becomes red and crystalline.

5. Show how the Oxides of Lead  $PbO$ ,  $Pb_3O_4$ ,  $PbO_2$ , conform to the law of multiple proportion, ( $Pb = 207$ ).



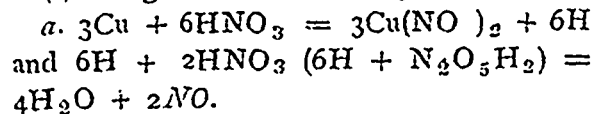
"When one body combines with another in several proportions, the higher proportions are multiples of the first and lowest." By inspection we see that this is the case with the Oxides of lead, here they conform to the law laid down.

6. Write equations respecting the following reactions :—

(a) Nitric acid on Copper.

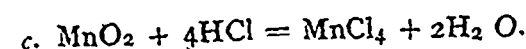
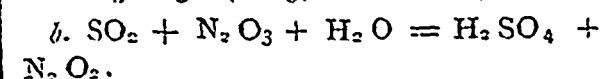
(b) Sulphur dioxide on Nitrogen trioxide and water.

(c) Manganese dioxide on Hydrochloric acid.



Nitric acid acting on copper always forms  $NO$ . As Nitric acid is formed by  $N_2O$ ,  $H_2O$  the Nitrogen Pentoxide must have been reduced to  $NO$ .

Three Oxygen have been removed. To remove three Oxygen, six Hydrogen atoms are necessary, hence to  $3Cu$  we must take  $8HNO_3$  and the full equation will be  $3Cu + 8HNO_3 = 3Cu(NO_3)_2 + 2NO + 4H_2O$ .



$MnCl_4$  cannot long exist but splits up into  $MnCl_2 + Cl_2$ , hence when Manganese dioxide acts upon Hydrochloric acid we obtain Chlorine.

## THE LONDON UNIVERSITY MATRICULATION EXAMINATION.

## WHAT TO READ AND HOW TO READ IT.

By WILLIAM DODDS, 1st B. A. (Lond.)

## CHEMISTRY.

Requirements.—Chemistry of the non-metallic elements, including their compounds as enumerated below, their chief physical and chemical characters, their preparation, and their characteristic tests.

Oxygen, hydrogen, carbon, nitrogen; chlorine, bromine, iodine, fluorine, sulphur, phosphorus, silicon.

Combining proportions by weight and by volume; general nature of acids, bases, and salts; symbols and nomenclature.

The atmosphere—its constitution; effects of animal and vegetable life upon its composition.

Combustion; structure and properties of flame nature and composition of ordinary fuel.

Water; chemical peculiarities of natural waters, such as rain-water, river-water, spring-water, sea-water.

Carbonic acid, carbonic oxide, oxides and acids of nitrogen, ammonia, olefiant gas, marsh gas, sulphurous and sulphuric acids, sulphuretted hydrogen.

Hydrochloric acid; phosphoric acid and phosphuretted hydrogen; silica.

The candidate for matriculation in this subject is required to prove his knowledge of the properties of the common non-metallic elements; the means and methods of obtaining each in a pure state, and of distinguishing one from another; the properties and composition of the compounds they form one with another; and of the symbolic language which is used to concisely express the quantitative relations of the elements entering into such compounds.

This knowledge can be most easily and thoroughly obtained by the practical study of the subject by means of experiment in addition to careful reading.

In Gill's *Chemistry for Schools*, published by Stanford, price 4s. 6d., the student will find a systematic course of experiments set forth with all necessary explanation of the manner of actually performing each. Those who have not the command of a well-furnished

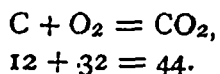
laboratory, may nevertheless perform some of the most useful and instructive experiments at a very small cost, since they involve the use of nothing in the way of apparatus but such as can be readily made by a student with a little glass tubing, a bottle or two, and some sound corks. Some experiments which are important and yet easily and cheaply made, are described in secs. 7, 9, 28, 39, 44, 47, 72, 86, 140, 141, 189, 191, 206, 217, 230, 252, 375, 376, 380, 381, and those in the chapter on Flame.

The 'Directions to the Reader' which immediately precede the table of contents in *Chemistry for Schools*, give useful general hints as to the course of study to be pursued; and we can only add, that for the purpose of matriculation, the most important points to master thoroughly are those relating to the composition, constitution and properties of air and water (chaps. ii—v.), and the elements contained in them; the nature of flame and the circumstances which alter its character (chap. xviii); the preparation and properties of the elements—chlorine, iodine, sulphur, phosphorus and carbon, and the compounds which they each form with oxygen and hydrogen respectively. Every reaction which has to be described in the examination room must be expressed in symbols as well as in words, and the candidate must be prepared to work out any simple quantity relating to the reactions involved in the preparation or decomposition of the commoner substances. The last point is of great importance, for though an examiner seldom considers a descriptive answer so full and complete, however accurate it may be so far as it goes, as to deserve full marks, he can hardly fail to give them to a numerical question which is fully and neatly solved. The student is therefore earnestly advised to work out as many of the quantitative questions which follow every chapter as he

can find time for. As specimen solutions occur abundantly in the text, he will find plenty of models on which to frame his own efforts. As an example of the questions of this kind which the candidate may expect to meet, we will take the following from the examination paper set in January, 1878:—

*'If air contains 23 per cent. of its weight of oxygen, how many lbs. of carbon must be burnt in order to remove all the oxygen from 500 lbs. weight of air?'*

In answering this, as in all other cases, first write out the equation which represents the reaction taking place. The reaction involved here is the union of carbon with oxygen; but carbon forms two compounds CO and CO<sub>2</sub>, one of which obviously contains twice as much carbon in proportion to the oxygen as the other. The question as put, though somewhat indefinite in form, implies that the *least* quantity of carbon (that which *must* be burnt) which will do the work is that which is required to be found. Hence, as the oxygen in air is 'free,' and the nitrogen takes no part in the action,



[Quantify this by writing the weights represented by the symbols under each, as is here done.]

The equation shows at a glance that 32 parts of oxygen 'must' have at least 12 parts of carbon to combine with, and therefore that 1 part of oxygen will need  $\frac{12}{32}$  parts of carbon.

But each 100 parts of air contains 23 parts of oxygen; therefore 500 lbs. of air contain  $5 \times 23 = 115$  lbs. oxygen, which will of course require  $115 + \frac{12}{32}$  lbs. of carbon to unite with.

As examiners frame their questions with a view to discourage cramming, *i.e.* unintelligent acquisition of ready-made information contained in text-books, many questions will be found to which no answer can be given from any one paragraph in any book, but which must be solved by piecing together the simple facts which ought to be familiar to every candidate, *e.g.*:—

*'A given powder is composed of 32 grains of sulphur and 56 grains of iron. How would*

*you ascertain whether the powder is a mechanical mixture or a chemical combination?'* (June 1878).

Here the answer is found by a few very simple reflections. If the powder is *mixture* of its constituents, it will exhibit the properties of both iron and sulphur; *e.g.*, treated with dilute hydric sulphate, the iron of it will dissolve and liberate hydrogen (sec. 39), leaving the sulphur behind enacted on; or if it be digested with carbon disulphide, the sulphur will be dissolved (sec. 142), leaving the iron. But, on the other hand, if the powder be a *compound*, it will have properties of its own differing *in toto* from those of either iron or sulphur; *e.g.*, it will dissolve entirely in dilute hydric sulphate, giving off sulphuretted hydrogen (sec. 147), and will be unaffected by the carbon disulphide. Again:—

*'How is olefiant gas prepared? By what means could you convince yourself that this gas contains twice as much carbon as an equal bulk of marsh gas does.'*

For the preparation of olefiant gas, see sec. 372. As both gases consist of carbon and hydrogen, both must yield carbonic dioxide and water when completely burnt; but if one contains more carbon than the other, it will yield more carbonic dioxide in the same proportion. Therefore if we mixed equal volumes of each with *excess* of oxygen in two graduated tubes fitted with platinum wires (as shown in sec. 50.), and passed an electric spark so as to bring about combustion, we should have left in each case a mixture of carbonic dioxide, and the excess of oxygen which was not needed for the combustion. By then passing up into each tube some solution of caustic potash or soda, the carbonic dioxide would be absorbed (sec. 379), and *the loss of volume* would be twice as great in the tube which originally contained olefiant gas as in the other.

*'A gas is composed of 92.3 parts of carbon 7.7 parts of hydrogen. How many atoms of hydrogen are united in this gas to two atoms of carbon.'*

An example of the solution of questions of

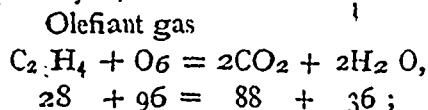
this kind is contained in secs. 387-389. As in the cases there given, we should here first see how many *atoms* instead of how many *units* of the two elements are united, thus :

$$\frac{92.3}{12} = 7.69, \text{ and } \frac{7.7}{1} = 7.7.$$

*i.e.* there are in this body sensible equal numbers of atoms; therefore two atoms of carbon are united to two atoms of hydrogen.

*'How many cc. of oxygen gas are required for the complete combustion of 200 cc. of olefiant gas? What products are formed, and how many cc. of each do you obtain.'*

As in all such numerical questions, first write out the equation respecting the reaction and quantify it, thus :—

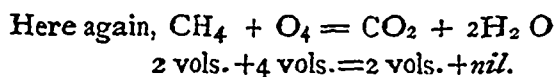


and if these numbers represent grammes, then the volumes will be

$2(11200 \text{ cc.}) + 6(11200 \text{ cc.}) = 4(11200 \text{ cc.}),$   
supposing the water found remains gaseous at the temperature of the experiment.

An inspection of the above equations shows that any volume of olefiant gas requires three times its volume of oxygen for complete combustion, and that the carbonic acid and water vapor formed are each double the volume of the original olefiant gas.

*'How is marsh gas prepared? If 100 volumes of this gas be exploded with 400 volumes of oxygen, what bulk of gas will remain, and of what will it consist.'*

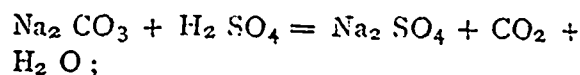


This shows that every volume of marsh gas requires two volumes of oxygen to burn it, and produces its own volume of carbonic acid, which only occupies one-third of the volume of the marsh gas and the oxygen together,—the water being condensed occupies an insig-

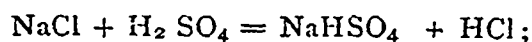
nificant volume; therefore the 100 volumes of marsh gas will consume 200 volumes of oxygen out of the 400, leaving the other 200 unchanged. So we shall have left 200 volumes of unchanged oxygen and 100 volumes of carbonic acid in place of the 500 volumes of *mixed* gases originally present.

*'A solution contains either carbonate of soda, chloride of sodium, or sulphide of sodium. How would you ascertain which of the three is present?'* (Jan. 1877.)

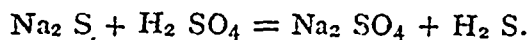
By the terms of the question, only one of the three named bodies can be present: therefore if we add dilute sulphuric acid, there will be liberated either carbonic acid, thus :—



or hydrochloric acid, thus :—



or hydric sulphide, thus :—



In the first case, a colourless almost inodorous gas, which will turn lime water milky, will be given off with brisk effervescence.

In the second case, no apparent change will take place till the mixture be heated, when a colourless gas of pungent acid odour and fuming strongly will come off.

In the third case, well-known smell of sulphuretted hydrogen will be readily perceived.

Other text-books used in preparing for this examination, but which our space forbids us to describe more particularly, are :—*Barff's Chemistry* (Groombridge, 4s.), containing a large number of questions already proposed, with answers; *Elementary Chemistry*, by Professor Roscoe (Macmillan, 4s. 6d.); and *Arithmetical Exercises for Chemical Students*, by C. J. Woodward, B.Sc. (Cornish & Son, s.; Key, 6d.).

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## PROMOTION EXAMINATIONS IN THE HAMILTON PUBLIC SCHOOLS.

The Course in the Public Schools of Hamilton is divided into twelve grades, namely : three first grades and then up to the tenth ; and, as Promotion Examinations are held twice a year, an intelligent pupil can begin his ABC's at five years of age and enter the Collegiate Institute at eleven. As a matter of fact, however, many pass the Entrance Examination at ten years of age, while the average age lies between thirteen and fourteen. The First Reader takes up two years of the course, the Second Reader one, the Third Reader one and a-half, and the Fourth Reader one and a-half. So thoroughly are the pupils grounded in their successive limits that at each semi-annual Entrance Examination all the pupils of the highest grade are sent up, and at the recent Examination out of 143 candidates who wrote, 113 passed. The following were the December Question Papers, for promotion from class to class in the Public School Course; the papers for entrance to High Schools were given last month:—

Omitting the questions in the three first grades, in which examination is oral, we begin with

*From the First Class to the Second, in the Public School Course—that is, from the Second to the Third Grade.*

### READING.

Page 52, 1st Reader, part II. The fourteen lines beginning "When George and Charles." Note pronunciation, fluency and expression. Value 30 marks.

### WRITING.

All the capitals and small letters, on slates. Value 30 marks.

### DICTATION.

Write on slates, in joined script letters, page 59, First Book, part II., from "At length when they were gone" to "so naughty again." Capitals are to be taken into account, but pupils are to be told where a sentence ends. Value 22 marks, with 2 marks off for each error.

### GEOGRAPHY.

What is Hamilton? What is a city? Into what parts is Hamilton divided? In which part do you live? How do you know where west is? What is your street and number? What direction does the street run? What direction do you come to school? What country do you live in? Examination oral; value 72 marks—eight each.

### ARITHMETIC.

I.—Find the sum of  $78699 + 98769 + 639 + 896948 + 46937 + 69 + 89 + 9$ .

II.—From 8,634,012,000,319 take 4,398,678,989,876.

III.—Write Roman Numerals for 18, 17, 9, 15, 13, 19, 16, 14, 12, 11.

IV.—Write figures for eighty-nine, seventy-six, one hundred and seventy-five, sixty-two, nine hundred and ninety-nine, one hundred and ten, forty-four, one hundred and five, fifty-five, thirty-eight.

V.—Find the value of  $984 - 376 + 869 - 469 + 367 - 694$ .

VI.—Find the difference between 6,321,442,967 and 2,398,678,409.

VII.—A man paid for a lot 569



dollars, and 899 dollars more than this for his house, and 250 less than the cost of the house for furniture. For how much must he sell them to gain \$398.

VIII.—Addition and Subtraction Tables; Numeration Table to 1,000.

IX.—What numbers do IX, XVI, XX, VI, IV, XIX, XVIII, XVII, XIV, XV, stand for?

X.—Easy problems in addition and subtraction:—

$2+3+5+6+7+8+9$  how many?

$6+7+9+8+4+6+3+8+4$  how many?

$7+4+6+9+5 - 4$  how many?

Value 100 marks, 10 each. The first seven are to be written on slates, and the last three oral.

#### LITERATURE.

Open books and answer orally from page 26:—

1. What is a "sad dunce"? (2) What are sums? (3) What is a glance? (4) What is meant by giving up in a rage? (5) Correct Harry's mistake "twice two are four, and two make eight." (6) What are *tame* mice? (7) What is a stage? (8) What is a cage? Page 45:—(9) What is meant by "he could not check his horse"? (10) What is a groom? (11) What is meant by "the brink of a steep bank"? (12) Why did Jack Stack's horse run away?

Value 6 for each; total 72 marks.

Omitting the questions for Promotion from the Third to the Fourth Grade, we give

*From Second to Third Class, Public School Course—that is, from the Fourth to the Fifth Grade.*

#### READING.

Second Reader page 157, from

"Edwin you seem" to "little drops of water." Note pronunciation, fluency and expression. Value 30 marks.

#### WRITING.

Copy Book, No. 2, Payson, Dunton & Scribner's series; and a specimen containing all the capitals and small letters and the ten digits. Value 20 marks.

#### DICTATION.

Second Reader, page 163, from "He soon appeared" to "waited Bruin's approach." Pupils are to be told where a sentence ends; capitals to be counted. Value 22 marks, with 2 marks off for each error.

#### GEOGRAPHY.

- (1.) What do you mean by a map?
- (2.) What county is Hamilton in?
- (3.) What railroads run into Hamilton?
- (4.) What is a county-town?
- (5.) What is the county-town of Wentworth?
- (6.) Point (Northern Hemisphere) to a continent.
- (7.) What is an ocean? point to one.
- (8.) " " river? "
- (9.) " " peninsula? "
- (10.) " " strait? "
- (11.) " " bay? "
- (12.) " " cape? "

Value 5 marks each.

(13.) Draw Wentworth; divide it into townships, and mark where Hamilton is. Value 12—Total 72 marks.

#### ARITHMETIC.

1. From the sum of  $68,754,321 + 1,234,578 + 875,469 + 9,876,548 + 34,789 + 789 + 97 + 6 + 5,879 + 9$ . take 48,697,486.

Must be done at once on paper. No marks unless correct and without changes.

2. Give Roman Numerals for 989, 870, 777, 555, 699.

3. Give figures for CCCXXXIII, DXCIV, CDXLIV, CMXCIX, DCCLXXXIX.

4. Find the product of 86,943,754 by 897.

5. Divide 65,436,745 by 768.

6. Write in words, ninety thousand, nine hundred and six; seventy-five thousand, four hundred and four; five thousand and five; forty thousand, four hundred and four; eighty-eight thousand, seven hundred and seven.

7. A man bought a farm for \$10,000, and gave for it 89 horses at \$98 each, and the rest in money; how much money did he give?

8. How many times can you subtract twelve from eight hundred thousand, seven hundred and nine?

• Oral.

9. Define sum, addends, minuend, subtrahend, remainder, quotient, divisor, dividend, multiplier, multiplicand and product.

10. Divide 56 apples into heaps of 7 each; how many heaps? Cost at 8 cts. per heap, at 12 cts., 13 cts., etc.

Divide 108 apples into heaps of 9 each; how many heaps? Cost at 1c., 2c., 3c., etc., per heap.

If 27 yds. cost \$3; how many yds. for \$1, \$2, \$8, etc.?

Value 10 marks each, total 100; the first 8 questions are to be written on slates, the last 2 oral.

#### LITERATURE.

Open books and answer orally—page 160:—

1. What is an "ingenious device"?

2. What is a factory, and what is the tall chimney for?

3. What is meant by "in his haste"?

4. What is a pulley?

5. What do you mean by "means of descending"?

6. What is a scaffold, and what is a ladder?

7. What is a keepsake, and why was it a keepsake?

8. Page 169.—What are backwoods and log shanty?

9. What is meant by "making both ends meet"?

10. What is a "pathless forest"?

11. Why did he say "it's no use crying"?

12. What is meant by "murmuring of the stream" and "the sound of the water increased"?

Value 6 marks for each; total 72.

Omitting the questions for promotion to the Sixth and Seventh Grades, w. give

*From the Third to the Fourth Class, Public School Course—that is, from the Seventh to the Eighth Grade.*

#### READING.

Third Reader, page 214, from "while this was going on" to "supper is getting ready." Note pronunciation, fluency and expression. Value 30 marks.

#### WRITING.

Copy Book, No. 4, Payson, Dunton & Scribner's series, and a specimen of eight lines of poetry, all the capitals and the ten digits. Value 20 marks.

#### DICTATION.

Third Reader, page 244, from "an

instant was enough" to "danger that awaited him." To be written at once on paper, no copy to be made, to be finished in twenty-five minutes; capitals and periods to count. Value 22 marks, with 2 off for each error.

## ARITHMETIC.

1. Multiply 86,974 by 987,65, and divide the product by 9,876. Must be done at once on paper. No marks unless correct and without changes.

2. Reduce 12 ac. 2 ro. 15 sq. per. 5 sq. ft. 76 sq. in. to square inches.

3. Find the L. C. M. of 9, 14, 16, 18, 24, 36, 38, 72, 64, 86.

4. Find the value of  $(4\frac{5}{8} - 2\frac{7}{12} + 5\frac{3}{8} - 3\frac{1}{2}) \times 35\frac{1}{2} \div 17\frac{3}{7}$ .

5. How many yards of carpet 2 ft. 3 in. wide will cover a room 17 ft. 9 in. long and 15 ft. 5 in. wide, and what will it cost at 75 cents per yard?

6. A merchant lost  $\frac{3}{5}$  of his capital, and then gained \$800, and was then worth \$4,000. How much did he lose?

7. How many times may £12. 12s. 11 $\frac{3}{4}$ d. be subtracted from £1,000, and what will the remainder be?

8. In walking 1 mile A took 1980 steps, and B 2880. Find the difference in the length of their steps.

9. How many steps must a boy take more than a man in walking 36 miles; the man's step being 2 ft. 9 in., and the boy's 1 ft. 10 in.?

10. A man worked 3 months of 25 days each, and 10 hours per day, at .08 cts. per hour, and received in payment 2 loads of grain, each containing 15 bags of 2 $\frac{1}{2}$  bush each. Find the price of grain per bush.

Value 100 marks, 10 for each, but no marks unless the right result is obtained.

## GEOGRAPHY.

1. Name and give position of cities in Ont.; 4 in Que.; 2 in N. B.; 1 in N. S.; 1 in P. E. I.; 1 in C. B. Value 18.

2. Draw Ont., marking on it, with names, 4 lakes, 4 rivers, 9 cities, islands. Value 21.

3. Draw N. A., putting in, with names, 3 oceans, 5 countries, 5 bays, 5 rivers, 5 capitals, 7 Canadian provinces, 3 large islands. Value 33, no marks if wrongly spelled or placed.

Total 72 marks.

## GRAMMAR.

1. How do we know that the word "interjection" has four syllables?

Value 6.

2. Tell whether the *w*'s and *y*'s are vowels or consonants in awkward, switch, lawyer, symbol, yew.

Value 1 each = 8.

3. Define etymology, gender, interjection, adverb. Value 2 each = 8.

4. Write two sentences with nouns in 1st person.

Two sentences with nouns in 2nd person.

Two sentences with nouns in 3rd person.

Underline words. 2 each = 10.

5. Write the genders of lady, woman, ox, sheep, goose, farmer, friend, wife, nephew, brother-in-law.

1 each = 10.

6. Separate into noun part and verb part:—

(a) By his keenness of scent he discovered the game.

(b) What's that?

(c) This dislike he one day manifested in a shocking manner.

(d) Give him the end of a rope.

(e) The brig Cecilia on one of her voyages had a fine Newfoundland dog on board.

(f) Delighted with his ingenuity, the spectators rewarded him liberally.

Value 3 each = 18.

7. Tell the parts of speech in the sentence—page 193, III. Reader—commencing "thus several," and ending with "head." Write the words in 3 columns, and opposite each word give the proper part of speech.

Value 1 each = 38.

#### HISTORY.

1. Who discovered America? When? Where did he sail from? Where did he land? Value 8.

2. Who discovered Canada? When? Where did he sail from? How did he come to call it Canada? Value 12.

3. What does "founding a city" mean? When was Quebec founded? By whom? When was Hamilton founded? By whom? Value 15.

4. What happened in Canada in 1759? Who were at war? What happened in 1792? What happened in 1812? Who were at war? Name 3 Canadian battle-fields. Value 18.

5. What happened in 1840?—in 1867? Value 6.

6. Name the provinces of the Dominion at the present time, with the date when each joined. Value 14.

Total 72 marks.

#### COMPOSITION.

1. Write three simple declarative sentences. 4 each = 12.

2. Write three simple imperative sentences. 4 each = 12.

3. What kind of a sentence is each of the following?—

(a) James, have you studied your lesson?

(b) James, study your lesson.

(c) James studies his lesson.

4 each = 12.

4. Correct where necessary:—

"I am Monark of awl i Seevey  
my Write their is Nantwo Dispute  
from the Senter at I round too the See  
i ane Lo of the Foulan d the braut."

Value 12.

5. Write a short description of the "sheep,"—1st. State in what countries the animal is found, and describe its appearance; and 3rd, Tell its principal uses. Value 20.

6. Write your own name and your teacher's name. Value 4.

Total value 72 marks.

#### LITERATURE.

Open books at page 192, and answer in writing:—

1. Why was Sir Jno. Moore buried so quietly? What is generally done when soldiers are buried?

2. What is a shroud? and what is a martial cloak?

3. What is meant by steadfastly gazed? and why did they think bitterly of the morrow?

4. What is meant by "upbraiding" and "little shall receive"?

5. Explain the use of that mark in they'll and that's, and give its name.

6. What is a ramm gun? the meaning of sullenly? and also of sory?

7. Page 193.—What do you mean by accustomed to look? and heroes?

8. What is the din of battle? the fury of the elements? melancholy death?

9. What is Lower Canada now called?

ed? What is a train? a locality?

10. What is meant by absence of light? aware of their dangerous position?

11. What is promptitude? and what is the conductor of a train?

12. What is meant by diminish? arouse the inmates? totally unconscious?

13. What is meant by enveloped the house? the proprietor?

14. What do you mean by a courageous man? by a fearful risk? and by a resolve?

15. Spell and give the meaning of heir, and all words pronounced like it, also of martial, he'll, o'er, Briton, seems.

Values: for the first 14, 5 each; for the 15th, 2.—total 72 marks.

9th Grade, being half way from entrance to fourth class to entrance to Collegiate Institute.

#### READING.

Fourth Reader page 134, from "at the height" to "gulf of eternity." Value 30 marks. Note the pronunciation, fluency, and expression.

#### WRITING.

Copy book No. 5, Payson, Dunton and Scribner's series, all the capitals and the ten digits. Value 20 marks.

#### DICTATION.

Page 92, from "there are some striking" &c. to "reach an asylum of liberty."

Time 20 minutes—To be written on the paper at once, when dictated; read the whole extract slowly, then read a few words at a time. Value 22 marks—2 off for each misspelled word.

#### ARITHMETIC.

1. Find the difference between the

product of 40687 and 879, and the quotient of 8769207 by 769. To be done on paper, and no marks to be given unless correct and free from changes or erasures.

2. Define a multiple of a given number, a common multiple of two or more numbers, the least common multiple of two or more numbers.

3. Multiply the difference between 125 lbs., 2 oz., 10 dwts., 13 grs., and 29 lbs., 8 oz., by  $97\frac{1}{2}$ .

4. Simplify  $\frac{5\frac{5}{8} \div \frac{2}{3}}{1\frac{1}{2} \text{ of } \frac{5}{8} \div 10\frac{2}{3}} \times \frac{2}{3}$  of

$1\frac{1}{2}$  of  $4\frac{1}{2}$

$13\frac{7}{8}$  of  $5\frac{1}{3}$

5. Simplify  $.01001 + 5.27 \times .000483 \div .030$ . Answer in decimals.

6. What will it cost to paper a room  $20\frac{3}{4}$  feet long,  $11\frac{1}{2}$  feet wide and  $12\frac{1}{4}$  feet high, with paper  $\frac{5}{8}$  of a yard wide at  $4\frac{1}{2}$  c. per yard?

7. Find the cost of a wall half a mile long, 4 feet high and 18 inches wide, at  $37\frac{1}{2}$  cents per cubic yard.

8. After spending  $\frac{1}{4}$  of my money, and then  $\frac{1}{3}$  of the remainder, and then  $\frac{1}{5}$  of what remains. I had \$300 left; how much had I at first?

9. How many horses must be bought at \$90 each, so that after allowing 90 cents for the food of each for a week, and then by selling each of them at \$120, there may be a gain of \$349.20?

10. If a man can paint 4 sq. yds. in 1 hour, and is 31 hours, 6 min. and 40 sec. in painting both sides of a wall 7 feet high; find the length of the wall.

10 marks for each.

#### GRAMMAR.

1. How do we know that "Hamilton" is a word of three syllables?—Value 3.

2. In yew, twenty, lawyer and woefully, are the w's and y's vowels or consonants? 1 each - 8.

3. Show proper and improper diphthongs and silent letters in

"O let our voice His praise exalt,  
Till it arrive at heaven's vault."

—1 each = 11.

4. Write principal parts of *flee, flower, fly, lay, lade, lie* (recline), *fall, feel, fell*, (Irreg. form first—capital R at end if reg, also.)—1 each = 9.

5. Decline fully in both numbers, thy, mice, which, one, son-in-law.—2 each = 10.

6. Define relation, comparative degree, potential mood, past-perfect tense.—2 each = 8.

7. 2nd, plu., pres.-per., ind., act. of *see* and *saw*; past tense of *can* (aux.) and *can* (to put in cans); present participle pas. of *do* and *dun* (to sue for debt).—2 each = 12.

8. Analyze; (a) Isn't that it? (b) Take care, sir; (c) There are many modes of solving the problem; (d) Armed with these powers they built a fort on James' Bay; (e) Out of seventy negro slaves not one returned but Dunez.—3 each = 15.

9. Parse—the *result of this* boyish effort to *invent* a system of *coloring* was *exhibited sixty-seven years afterwards with the celebrated picture*—"Christ rejected."—2 each = 24.

#### GEOGRAPHY.

1. Draw a hemisphere, marking on it, with names, poles, equator, meridians, circles, tropics, parallels, zones. Value 14.

2. Draw Ontario, marking on it 5 rivers and 9 cities.—Value 14.

3. Draw Africa, marking on it 5 seas, 4 mountains, 6 bays, 3 lakes, 4 capes.—Value 22.

4. Draw Europe, marking on it 15 countries, 15 capitals, 14 rivers.—Value 22.

*No mark if wrongly spelled or placed.*

#### COMPOSITION.

1. Form into a compound sentence:

Rivulets descended from the mountains on every side.

Rivulets filled the valley with verdure.

Rivulets filled the valley with fertility.

Rivulets formed a lake in the middle.

The lake was inhabited by fish of every species.

The lake was frequented by fowl of every kind.—Value 12.

2. Change construction by *voice* :—

(a) All the people have been elated at Hanlan's success.

(b) Luther immediately wrote a letter full of the most tender solicitude.

(c) Shall I never see his face again? —3 each = 9.

3. Change by *emphatic* and *progressive forms* :—

(a) He lived in Hamilton during the civil war.

(b) The cattle find excellent pasture by the river.—2 each = 8.

4. Write 3 compound sentences on the "*sun*."—3 each = 9.

5. Correct mistakes in capitals, spelling and punctuation :—

"jackson went out, evry day to Labor an as duely, came back to Prison at night in the month of may, the Sherrif prepaired to Conduct him too springfeild were he was to be Tryed fore high Treasin jackson, sed this wood be kneadless expence."—Value 10.

6 Classify as regards both *nature* and *structure* :—

(a) James, go and study your lesson.

(b) James, did you study your lesson?

(c) James did study his lesson.—2 each = 12.

7. Write a short composition on *Wheat*.

1st—State what it is, and in what countries it grows.

2nd—Describe its structure and cultivation.

3rd—Tell something of its usefulness to man.—Value 12.

## HISTORY.

1. What happened in 1497, 1535, 1608, 1759, 1776, 1792, 1812, 1840, 1867, 1870, 1871, 1873?—Value, 12.
2. Explain Treaty, Responsible Government, U. E. L.—Value 3.
3. Name the rulers of England since 1066 in order, giving relationship to predecessor, and one event of each reign.—Value 57.
- Total, 72 marks.

## LITERATURE.

- |                                   |   |
|-----------------------------------|---|
| Values                            | Books open, but all notes, etc. must be removed. Page 139.  |
| 2 + 2<br>+ 2<br>= 6               | 1. What is meant by "set afloat by Spain," "inseparably associated?" Parse among.   |
| 2 + 2<br>= 4                      | 2. Who was Diego Valasquez? What is the subject of was committed?   |
| 1 + 1<br>+ 1<br>+ 1<br>+ 2<br>= 6 | 3. What is meant by—vessels lay to, hostility, wild rumors, cruel excesses? What cruel excesses had the Spaniards been guilty of? |
| 1 + 4<br>= 5                      | 4. What is the meaning of—Personal interview? Respectfully declined? Aspect? Towered aloft? Gorgeous?                             |
| 2 + 1<br>= 4                      | 5. Name the senses. What sense could they scarcely believe?   |
| 1 + 4<br>= 5                      | 6. What is the meaning of Accommodations? Hospitality? Treachery? Entertainers? Hold expedient?                                   |

## Values

- |                     |   |
|---------------------|---|
| 1 + 1<br>+ 1<br>= 3 | 7. Give the meaning of—"subsequently the war was continued" in your own words. What are desperate resistance and unrelenting cruelty?     |
| 2 + 1<br>+ 1<br>= 4 | 8. Where and what is Castile? What are benefactors, and what is breach of etiquette?<br>Books open, but all notes, &c. removed. Page 149. |
| 8                   | 9. Tell what you know of Columbus.  |
| 2 + 2<br>= 4        | 10. What is the subject of smiles? Explain Elysian isles.   |
| 2 × 4<br>= 8        | 11. What is meant by Orion? Perennial verdure? Ambrosial fruits? Amaranthine flowers?   |
| 3 + 2<br>= 5        | 12. In what sense is man used in l. 16 and what is the antecedent of she, in l. 17.   |
| 4 + 4<br>= 8        | 13. Give the rules for "When," "And" and "Amidst" beginning with capital letters, and also "Nature" before <i>Free</i> .                  |
| 3                   | 14. Spell and give the meaning of O'er and all other words pronounced the same way.   |
| 72                  | Marks.  |

NOTE.—To pass from any one grade to the next higher, a candidate must make at least one-third of the marks in each subject, as well as half the total.

Pupils after passing through the subsequent Tenth Grade, pass the examination for entrance to the Collegiate Institute, there being no Fifth Class of the Public School Course in the Hamilton Public Schools.

The Head Masters of the Walkerton and Kincardine High Schools get salaries of \$1,200 and \$1,000 respectively, those of their assistants being \$550 and \$500. Kincardine has a

second assistant at \$450. The Head Master of the Walkerton Public School gets \$750, and of the Kincardine Public School \$800.

## SOME POINTS FOR YOUNG TEACHERS.

## QUESTIONING THE CLASS.

1. Remember that every question is a link in a chain, and it should be suggested by something which precedes or something which follows.

2. Compel yourself to invent your own questions, relying upon what you know of the subject to suggest them.

3. If you do not understand the subject well enough to ask your own questions, conscientiously review with this in view.

4. Ask your questions in the order of the development of the subject, so that the answers will be its complete evolution.

5. Thus form in yourself and in the pupils the habit of discussing a subject logically. This habit of thought is worth infinitely more than the knowledge of the subject.

6. When pursuing such a train of questions, occasionally ask your pupils what questions you should ask next. Those who are really *following* the discussion will anticipate the most of your questions.

7. Sometimes, after you have thus developed a train of thought along the

subject studied, by a connected series of questions, call upon some bright pupil to ask the same series of questions to the class. This will test his mastery of the subject most thoroughly.

8. This connected questioning will excite the close and *continued* attention of your class. There is inspiration in it.

9. Never permit your class to answer in concert unless you give them the word, such as "together!" When this or some equivalent sign is not given, they should understand that they must raise their hands and no one is to reply until called upon. Enforce this strictly. You will be the careless one.

10. Rarely repeat a question a second time, and never repeat the answer after the pupil. Either of these practices breeds inattention.

11. Let your questions be mainly to individuals, rarely to the whole class.

12. Let concert recitations be mainly of the answers first given by a pupil. Thus by repetition fix in the minds of all what has been first recited by one.

—*Normal Teacher.*

## EDITORIAL NOTES.

The Board of Education for the Town of Bowmanville, petition the Minister of Education to have the examination papers in mathematics made less difficult than they have hitherto been, and to allow girls an option between mathematics and "additional English or other useful subjects." This Board is of opinion that to a certain extent the complaints against the unfair character of the examination questions set in mathematics are well founded. To give less prominence to

mathematics in all of our School examinations and more attention to other departments, especially English and Science, would be a movement in the right direction.

The Stratford Board of Education have sent a memorial to the Minister of Education asking that in future the full text of the High School Inspectors' Report on the condition of a school be sent to the Board. They state that their present reports are meagre and



unsatisfactory ; that they should contain specific information as to the capacity of teachers and the progress made by the pupils in the subjects taught. We doubt if the memorial will have the effect of making the inspectors' reports any more satisfactory than they are at present. What is wanted is the division of the Province into three districts, and the appointment of an inspector over each section, with something more than inspectoral powers. At present an inspector visits a school once in eighteen months, and the wonder is that he knows the school at all. How an inspector can report on the "progress made by pupils in each subject taught" when his visits are not more frequent than once in eighteen months is difficult to imagine.

THE CANADA PUBLISHING COMPANY of Toronto announce that they have made arrangements to publish a series of large wall maps for schools. These maps are superior to anything heretofore used in the schools of Ontario. The physical features are boldly and distinctly delineated, and the political boundaries carefully colored. The principal railways and steamship routes are shown so that practical geography can be taught from the map. Each map is mounted on rollers and varnished ; the smallest one of the series is 5 feet 8 inches by 4 feet 6 inches.

The following circular letter has been sent to us for publication ; it is addressed to the young ladies attending the High Schools and Collegiate Institutes of Ontario :

The question of the higher education of women has been much discussed of late, and it now has the sympathy and encouragement of the best authorities of the day. Canadian women were, until April, 1880, debarred from the privilege of studying medicine in their own country. The

Faculty of the Royal College, Kingston, Ont., have been the first to recognize the justice of allowing women to enter the medical profession, and last spring issued circulars (one of which please find enclosed) saying that in future they would hold a *separate* session for ladies, to extend from April 1st to October 1st of each year. A few, myself included, took advantage of this, and last summer we had a very successful session.

Many of you, doubtless, are looking forward to a life of study, and perhaps of independence. What better means than this? As civilization has advanced, the popular prejudice against the study of medicine by women has been melted from the public mind. My fellow students and I can testify that the study of medicine is a most interesting and delightful work to one who takes it up earnestly. Ignorance has fostered for many years the idea that the study of medicine is unfit for women. What more elevating, what more calculated to improve any mind than a thorough knowledge of the divine construction of the human frame and of the laws which govern its safe keeping, and what nobler field before a woman than to administer to the sufferings of her own sex?

To all who are sensible, true women, who have an earnest desire for the improvement of not only yourselves, but of your whole sex, we will give every encouragement and assistance.

We will be very glad to hear from any of you who contemplate studying medicine, and, in fact, from any who are interested in this important subject. We will be very happy to furnish any who may write with every particular concerning the work, examinations, boardings, &c.

Yours most sincerely,

ALICE MCGILLIVRAY,

Box 794, Kingston.

Kingston, Jan. 1st, 1881.